"THE EFFECTIVENESS OF RESPIRATORY MUSCLE TRAINING PROGRAM (RMT) IMPROVES TOTAL LUNG VOLUMES AND CAPACITIES AND REDUCES FATIGUE IN PATIENTS WITH MULTIPLE SCLEROSIS"

A Dissertation Submitted to

THE TAMILNADU Dr. M.G.R MEDICAL UNIVERSITY

CHENNAI

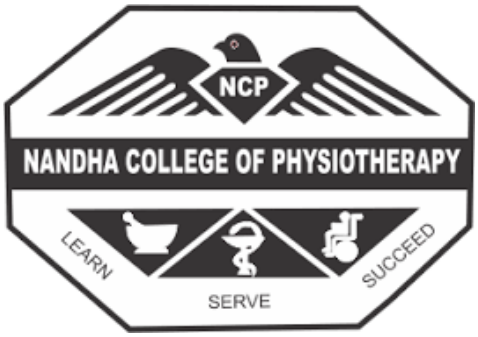
In partial fulfillment of the requirements for the award of the

MASTER OF PHYSIOTHERAPY DEGREE

(*PHYSIOTHERAPY IN NEUROLOGY*)

Submitted by

Reg. No. 271620061



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The Dissertation entitled

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Under the guidance of

Prof. V. VIJAYARAJ, M.P.T (Neuro)., M (Acu)., DVMS., M.I.A.P

A Dissertation submitted to

THE TAMILNADU Dr. M.G.R MEDICAL UNIVERSITY

CHENNAI.

Dissertation Evaluated on _____

Internal Examiner **External Examiner**

CERTIFICATE BY THE HEAD OF THE INSTITUTION

Prof. V. MANIVANNAN M.P.T (Ortho).,
Principal/HOD-Department of Orthopaedics,
Nandha College of Physiotherapy,
Erode -638 052.

This is to certify that the dissertation entitled **"THE EFFECTIVENESS OF RESPIRATORY MUSCLE TRAINING PROGRAM (RMT) IMPROVES TOTAL LUNG VOLUMES AND CAPACITIES AND REDUCES FATIGUE IN PATIENTS WITH MULTIPLE SCLEROSIS"** is a bonafide complied work, carried out by **Register No:**271620061 **,** Nandha College of Physiotherapy , Erode – 638 052 in partial fulfillment for the award of degree in Master of Physiotherapy as per the doctrines of requirement for the degree from **THE TAMILNADU Dr. M.G.R. MEDICAL UNIVERSITY, CHENNAI-32.** This work was guided and supervised by

Prof. V. VIJAYARAJ, M.P.T(Neuro)., M(Acu)., DVMS., M.I.A.P

I wish her a great success in her dissertation work.

DATE:

PLACE: **PRINCIPAL SIGNATURE**

CERTIFICATE BY THE GUIDE

Prof. V. VIJAYARAJ, MPT (Neuro).,M(Acu)., DVMS., M.I.A.P.,
HOD-Department of Neurology,
Nandha College of Physiotherapy,
Erode-638 052.

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This work was done under my personal guidance.

Date:

Place: **GUIDE SIGNATURE**

DECLARATION

I hereby and present my project work entitled **"THE EFFECTIVENESS OF RESPIRATORY MUSCLE TRAINING PROGRAM (RMT) IMPROVES TOTAL LUNG VOLUMES AND CAPACITIES AND REDUCES FATIGUE IN PATIENTS WITH MULTIPLE SCLEROSIS"** is outcome of original research work was undertaken and carried out by me under the guidance of **Prof. V. VIJAYARAJ, MPT (Neuro)., M(Acu)., DVMS., M.I.A.P.,**

To the best of my knowledge this dissertation has not been formed in any other basis for the award of any other degree, diploma, associateship, fellowship, previously from any other medical university.

Reg.No: 271620061

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I dedicate this work and its outcome to all the above listed and unlisted well wishers of me. I once again thank everyone who has supported me in all the aspects for fulfilling my project work.

PREFACE

It was an immense pleasure for me to present this project work on **"THE EFFECTIVENESS OF RESPIRATORY MUSCLE TRAINING PROGRAM (RMT) IMPROVES TOTAL LUNG VOLUMES AND CAPACITIES AND REDUCES FATIGUE IN PATIENTS WITH MULTIPLE SCLEROSIS"** I have done this work with my best level by referring many books, journals and websites. I believe this project will give basic knowledge in the field of multiple sclerosis.

And also, I believe this project work will very helpful for the Physiotherapists to given better treatment for multiple sclerosis patients.

Reg. No. 271620061

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CHAPTER-1

1.1 INTRODUCTION

Multiple sclerosis (MS) is an inflammatory disease of the central nervous system that results in myelin destruction and axonal degeneration in the brain and spinal cord.

Multiple sclerosis (MS) results in peripheral muscle weakness and fatigue. Typically, respiratory muscle fatigue is observed in later stages of MS, leading to disability and ultimately mortality.

However, more recent studies have demonstrated respiratory muscle weakness in ambulatory individuals with MS that have nor minimal signs and symptoms and normative pulmonary function. Most studies implementing exercise to reduce MS-related fatigue have concentrated on whole-body exercise and neglected to address the importance of the respiratory muscles.

Limitations to inspiratory muscle function compromise other working muscles as well as exercise performance.MS-related respiratory muscle dysfunction involves both the inspiratory and expiratory muscles; however, expiratory muscle strength deteriorates earlier in the disease course than inspiratory muscle strength.

Studies have shown that expiratory muscle training can enhance expiratory functions in addition to improving functional performance. Others have investigated the effects of inspiratory muscle training in MS.Although respiratory muscle training (RMT) is beneficial to individuals with MS, none of these studies performed a combined training nor did they attempt to include measures of fatigue and/or quality of life.

Previous studies on healthy individuals with normative respiratory muscle strength and pulmonary function have shown that a 5-week combined inspiratory and expiratory muscle training protocol improved inspiratory and expiratory muscle strength as well as whole-body exercise performance.

The purpose of this study was to investigate the effects of a 5-week combined inspiratory and expiratory muscle progressive resistance training program on respiratory muscle strength and overall fatigue self-efficacy, and functional performance in individuals with mild to moderate MS.

We hypothesized that a combined inspiratory and expiratory muscle training protocol would improve respiratory muscle strength and reduce fatigue, and functional performance in individuals with MS.

1.2 OPERATIONAL DEFINITIONS:

1.2 (a) MULTIPLE SCLEROSIS:

Multiple sclerosis is a common demyelinating disease, normally characterized by focal disturbance of function and a relapsing and remitting course.

1.2 (b) FATIGUE:

Fatigue is defined as a state during when a person is unable to carry out a particular activity any longer after performing it repeatedly for some time.

1.2 (c) INSPIRATION:

Inspiration is the active part of the breathing process, which is initiated by the respiratory control center in medulla oblongata (Brain stem).

1.2 (d) EXPIRATION:

Expiration is a passive event due to elastic recoil of the lungs.

1.2 (e) LUNG VOLUME AND CAPACITIES:

LUNG VOLIME:

Lung volumes are the volume of air breathed by an individual each of this volume of air present in the lung under a specific static condition.

LUNG CAPACITIES:

The total lung capacity (TLC), about 6,000 mL, is the maximum amount of air that can fill the lungs (TLC = TV + IRV + ERV + RV).

Key words:

TV- Tidal volume.

IRV – Inspiratory reserve volume.

ERV- Expiratory reserve volume.

RV – Residual volume.

1.3 NEED FOR THE STUDY:

- The purpose of this study was to investigate the effects of a Respiratory Muscle Training Program improves total lung volume and capacities and reduce the level of fatigue in patients with multiple sclerosis.
- Multiple sclerosis may have a negative impact on the daily activities of patient.
- It also affects the emotional, physical and functional activities of life.

Hence I concluded to do my research effect of a Respiratory Muscle Training Program improves total lung volumes and capacities and reduce the level of fatigue in patients with multiple sclerosis.

1.4 AIM OF THE STUDY:

The aim of the study to find out the effects of a Respiratory Muscle Training Program improves total lung volumes and capacities and reduces fatigue in patients with multiple sclerosis.

1.5 OBJECTIVES OF THE STUDY:

- To have in-depth knowledge in multiple sclerosis patients.
- To improve total lung volumes and capacities and reduce fatigue in patients with multiple sclerosis.
- To determine the effect of a Respiratory Muscle Training Program improves total lung volumes and capacities and reduce the level of fatigue in patients with multiple sclerosis.

1.6 VARIABLES OF THE STUDY:

1.6 (a) INDEPENDENT VARIABLE:

Respiratory Muscle Training Program (RMT).

1.6 (b)DEPENDENT VARIABLE:

Pulmonary Function Test (PFT).

Modified Fatigue Impact Scale (MFIS).

1.7 HYPOTHESIS:

1.7 (a) NULL HYPOTHESIS:

There will be no significant improvement in the effects of a Respiratory Muscle Training Program improves total lung volumes and capacities and reduces fatigue in patients with multiple sclerosis.

1.7 (b) ALTERNATE HYPOTHESIS:

There will be significant improvement in effects of a Respiratory Muscle Training Program Improves total lung volumes and capacities and reduce the level of fatigue in patients with multiple sclerosis.

1.8 ASSUMPTION:

The study has been conducted assuming that effects of a Respiratory Muscle Training Program improves total lung volumes and capacities and reduce the level of fatigue in patients with multiple sclerosis.

1.9 PROJECTED OUTCOME:

Based on the literature review, it is expected that there will be a significant improvement in effects of a Respiratory Muscle Training Program improves total lung volumes and capacities and reduce the level of fatigue in patients with multiple sclerosis.

CHAPTER-II

REVIEW OF LITERATURE

1. Ferreira GD, Costa AC, Plentz RD, Coronel CC, Sbruzzi G. (2016)

Among neurodegenerative diseases, multiple sclerosis (MS) and amyotrophic lateral sclerosis (ALS) have a high rate of respiratory disability. To analyze the effects of respiratory muscle training (RMT) on ventilatory function, muscle strength and functional capacity in patients with MS or ALS RMT can be an adjunctive therapy in the rehabilitation of neurodegenerative diseases improving ventilatory function and respiratory strength.

2. Ray AD, Mahoney MC, Fisher NM (2015)

This article examines the association between measures of respiratory muscle function and fatigue in individuals with mild-to-moderate disability multiple sclerosis (MS).

3. Martín-Valero R, Zamora-Pascual N, Armenta-Peinado JA. (2014)

It was observed that subjects who had minor scores in the Kurtzke Expanded Disability Status Scale showed changes in maximum inspiratory and expiratory pressures after respiratory muscle training. In future studies, it would be suitable to take into account both inspiratory and expiratory muscle training.

4. Chisari C, Venturi M, Bertolucci F, Fanciullacci C, Rossi B. (2014)

Exercise is well tolerated and induces relevant improvements in physical and mental functioning of persons with Multiple Sclerosis (MS). An intensive task-oriented rehabilitation protocol is effective in improving motor function and has a positive impact on quality of life in MS patients with moderate disability.

5. Ray AD, Udhoji S, Mashtare TL, Fisher NM (2013)

To determine the effects of a short-duration, combined (inspiratory and expiratory), progressive resistance respiratory muscle training (RMT) protocol on respiratory muscle strength, fatigue, health-related quality of life, and functional performance in individuals with mild-to-moderate multiple sclerosis (MS).

6. Carvalho SR, AlvarengaFilho H, Papais-Alvarenga RM, Chacur FH, Dias RM (2012)

Impairment of respiratory function has been described in end-stage multiple sclerosis (MS), as well as in patients with mild to severe disability. The objective of this study was to assess the pulmonary function, respiratory muscle strength and carbon monoxide diffusion capacity of the lungs (DL(CO)) in patients with relapse remitting multiple sclerosis (RRMS) without disability.

7. Kargarfard M, Etemadifar M, Baker P, Mehrabi M, Hayatbakhsh R (2012)

To examine the effectiveness of aquatic exercise training on fatigue and health-related quality of life (HRQOL) in women with multiple sclerosis (MS). The findings suggest that aquatic exercise training can effectively improve fatigue of patients with MS and should be conducted

8. Bosnak-Guclu M, Gunduz AG, Nazliel B, Irkec C.(2012)

To compare functional exercise capacity, pulmonary function and respiratory muscle strength in fully ambulatory patients with multiple sclerosis with different disability levels and healthy controls, and to elucidate the determinant factors of functional exercise capacity.

9. Pfalzer L, Fry D. (2011)

Pulmonary muscle weakness is common in ambulatory people with multiple sclerosis (MS) and may lead to deficits in mobility function. The purpose of this study was to examine the effect of a 10-week home-based exercise program using an inspiratory muscle threshold trainer (IMT) on the results of four lower-extremity physical performance tests in people with MS.

10. Kayes NM, Schluter PJ, McPherson KM, Taylor D, Kolt GS (2009)

To revise the Physical Activity Disability Scale (PADS) and to explore the acceptability and test-retest reliability of the revised measure, the PADS-R, in people with multiple sclerosis.

11. Fry DK, Pfalzer LA, Chokshi AR, Wagner MT, Jackson ES (2007)

Pulmonary impairments have long been recognized as major causes of morbidity and mortality in individuals with advanced multiple sclerosis (MS). This study was designed to determine if a 10-week home exercise inspiratory training program in community-dwelling persons with MS improves pulmonary muscle strength and endurance

12. Mutluay FK, Demir R, Ozyilmaz S, Caglar AT, Altintas A, Gurses HN (2007)

To explore the effectiveness of breathing-enhanced upper extremity exercises on the respiratory function of patients with multiple sclerosis. The programme improved most pulmonary performance measures and had clinical significance. Its sustained application may prevent respiratory complications frequently observed in the later stages of multiple sclerosis

13. Chiara T, Martin D, Sapienza C (2007)

This study investigated the effect of expiratory muscle strength training (EMST) on voice production, dysarthria, and voice-related quality-of-life issues in persons with multiple sclerosis (PwMS). It was hypothesized that PwMS would have improved voice production and reduced voice-related quality-of-life issues following EMST

14. Chiara T, Martin AD, Davenport PW, Bolser DC. (2006)

To determine the effect of expiratory muscle strength training (EMST) on maximal expiratory strength, pulmonary function, and maximal voluntary cough in persons with multiple sclerosis (MS) having mild to moderate

15. Mutluay FK, Gürses HN, Saip S (2005)

To measure respiratory functions of ambulatory patients with multiple sclerosis and compare the results with expected values from healthy general population data. Further, to study the correlation of respiratory function impairment with the multiple sclerosis-induced disability level.

16. Chetta A, Rampello A, Marangio E, Merlini S, Dazzi F, Aiello M, Ferraro F, Foresi A, Franceschini M, Olivieri D (2004)

We conclude that in MS patients with mild disability, fatigue and exertion dyspnea are different sensations without any link and a peripheral limitation during walk can occur.

17. Klefbeck B, HamrahNedjad J (2003)

To evaluate whether inspiratory muscle training (IMT) improves inspiratory muscle strength, respiratory capacity, fatigue, and subjective perception of physical endurance in patients with advanced multiple sclerosis (MS).

18. Mathiowetz V, Matuska KM, Murphy ME (2001)

To evaluate the efficacy of an energy conservation course on fatigue impact, self-efficacy, and quality of life (QOL) for persons with multiple sclerosis (MS). Results provide strong evidence for the efficacy of this energy conservation course for persons with MS.

19. Gosselink R, Kovacs L, Ketelaer P, Carton H, Decramer M (2000)

To evaluate the contribution of respiratory muscle weakness (part 1) and respiratory muscle training (part 2) to pulmonary function, cough efficacy, and functional status in patients with advanced multiple sclerosis (MS)

20. Provinciali L, Ceravolo MG, Bartolini M, Logullo F, Danni M (1999)

To test the feasibility of a multidimensional assessment based on both task-related and self-evaluation questionnaire scores in patients with multiple sclerosis (MS); ii) to correlate the results from selective measures with the severity of illness in terms of the Expanded Disability Status Scale (EDSS) score; iii) to assess the relationships between different domains of MS-related disability and handicap

21. Harms CA, Babcock MA, McClaran SR, Pegelow DF, Nickele GA, Nelson WB, Dempsey JA (1997)

We hypothesized that during exercise at maximal O2 consumption (VO2max), high demand for respiratory muscle blood flow (Q) would elicit locomotor muscle vasoconstriction and compromise limb Q. We conclude that work of breathing normally incurred during maximal exercise causes vasoconstriction in locomotor muscles and compromises locomotor muscle perfusion and VO2.

22. Lundmark P, Bränholm IB (1996)

Activity is essential for all human beings, and provides a means through which human beings develop, gain recognition, and fulfil life's goals. The focus for this study was on activities performed by people with a chronic disease and their effects on experienced life satisfactionThirty subjects with multiple sclerosis (MS) were interviewed with regard to activities of daily living (ADL), and checklists were used for activity preferences and levels of satisfaction with life as a whole and with nine domain-specific forms of life satisfaction. The results of the study reveal 14 of the subjects to be satisfied and 16 to be dissatisfied

23. Foglio K, Clini E, Facchetti D, Vitacca M, Marangoni S, BonomelliM,Ambrosino N (1994)

Patients with multiple sclerosis (MS) show a poor exercise tolerance. A reduction in respiratory muscle strength has also been reported. The purpose of this study was to evaluate whether reduction in exercise tolerance was related to respiratory muscle dysfunction

24. Smeltzer SC, Skurnick JH, Troiano R, Cook SD, Duran W, Lavietes MH(1992)

The aim of this study was to assess the utility of clinical assessment of respiratory muscle weakness in MS.

25. Krupp LB, Alvarez LA, LaRocca NG, Scheinberg LC (1988)

Fatigue is a frequent symptom in multiple sclerosis (MS) that can interfere with a patient's daily functioning. Structured interviews were conducted with 32 patients with MS and 33 normal healthy adults. Fatigue proved to be both more frequent and more severe among the patients with MS Multiple sclerosis fatigue appears to be a distinct clinical entity, often disabling, that can be distinguished from normal fatigue, affective disturbance, and neurologic impairment.

CHAPTER-III

MATERIALS & METHODOLOGY

3.1MATERIALS

- Nose clip.
- T-shaped mouth piece.
- Pressure transducer.
- Portable computer.
- Respiratory muscle training device
- Spirometry.
- Stop watch.

3.2METHODOLOGY

- All patient underwent neurological examination and respiratory evaluation.
- Pulmonary Function Test is conducted to know lung volumes and capacities in multiple sclerosis patient.
- MFIS is conducted to know how fatigue affect the multiple sclerosis patient.

3.2.1. POPULATIONS

Patient with age group 30 years and above affected by multiple sclerosis.

3.2.2 STUDY DESIGN

☆ Quasi Experimental design

- Pre and Post experimental Study Design

3.2.3. STUDY SETTING

- Sudha Institute of Medical Sciences-Erode.
- Neuro Specialty Hospital-Erode.
- Govt. Head Quaters Hospital-Erode.
- Senthil Multi Specialty Hospital- Erode.

3.2.4 STUDY DURATION

Study was conducted for a period of 12 months.

3.2.5. TREATMENT DURATION

- ✓ Study was carried out for 5 weeks for each individual.
- ✓ Group A patients received Respiratory Muscle Training Program was performed thrice a week (each session lasted for 20 to 30 minutes)

- ✓ Group B patient received Pursed Lip Breathing Exercise and Spirometry exercise was performed thrice a day.

3.2.6. STUDY SAMPLING

- ➢ Convenient Sampling Method.

3.2.7. SAMPLE SIZE

A total number of 30 subjects with Multiple Sclerosis Patients.

- ➢ Group A-15
- ➢ Group B-15

3.2.8. CRITERIA FOR SELECTION:

(a) INCLUSION CRITERIA:

- Multiple sclerosis mild to moderate.
- 30 years and above.
- The ability to walk at least 100m.
- Both male and females.
- Participants had to be able to perform aerobics.
- Participants had to be able to perform the breathing maneuver.

(b) EXCLUSION CRITERIA:

- Current or past neurological condition other than MS and MS relapse within the past 4 weeks.
- Breathing difficulty.
- Respiratory infection within the past 4 weeks new corticosteroids use within the last 4 weeks.
- Smokers.
- Participating rehabilitation program.

3.2.9. PARAMETER:

The subjects of both groups underwent PFT and MFIS to know the severity of Tidal volume, vital capacity and Reduce the Fatigue level of the patients with Multiple sclerosis.

- Pulmonary Function Tests (PFT).
- Modified Fatigue Impact Scale (MFIS).

3.2.9 (a) PULMONARY FUNCTION TEST(PFT):

- ✓ Pulmonary function tests or lung function tests are useful in assessing the functional status of the respiratory system both in physiological and pathological conditions.
- ✓ Lung function tests are based on the measurement of volume of air breathed in and out in quiet breathing.
- ✓ These tests are carried out mostly by using Spirometry.

3.2.9(b) MODIFIED FATIGUE IMPACT SCALE(MFIS):

- ✓ The MFIS is a modified form of the Fatigue Impact Scale based on items derived from interviews with MS patients concerning how fatigue impacts their lives.
- ✓ This instrument provides an assessment of the effects of fatigue in terms of physical, cognitive, and psychosocial functioning.
- ✓ The full-length MFIS consists of 21 items while the abbreviated version has 5 items. The abbreviated version can be used if time is limited but the full-length version has the advantage of generating subscales.

3.2.10. TECHNIQUE AND APPLICATION

The subject who participated study divided into two Groups, Group A and Group B.

- ➢ (a) Group A received Respiratory Muscle Training Program (RMT).
- ➢ (b) Group B received Pursed Lip Breathing Exercise with Spirometry exercises.

PROCEDURE

- ✓ The diagnosis, age, gender and duration of onset of multiple sclerosis obtained from patients interviews and medical charts.
- ✓ All those who met inclusion criteria were randomly assigned into Group-A received Respiratory Muscle Training program (RMT) in Group B received Pulsed Lip Breathing exercise with Spirometry exercise.
- ✓ A detailed assessment of every subject was done.
- ✓ On the day of initial assessment a pre score were taken for all the selected subjects and again a post score for both the scale were collected at the end of training session which was at five weeks.

PROTOCOL

- ☆ Pretesting was performed over 2 days, separated by 1 week.
- ☆ On day 1, patients completed the informed consent form and all functional testing. On day 2, the participants performed pulmonary function tests and completed the questionnaires.
- ☆ Post testing was performed after the completion of the 5-weeks RMT program.

GROUP- A

RESPIRATORY MUSCLE TRAINING PROGRAM

The subject of the Group A underwent RMT program as per the procedure

- ✓ RMT was performed for 30 minutes, 3days/week., for 5 weeks.
- ✓ Participants were required to perform the first training session of each week in the laboratory and the other 2 training sessions per week at home.
- ✓ The participants wore a nose clip and breathed through a T-shaped mouthpiece with spring-loaded inlet and outlet valves.
- ✓ The mouthpiece was connected to a pressure transducer and a portable computer.
- ✓ Participants were asked to exhale completely, place the mouth-piece in their mouth, inhale completely against a known resistance and, and completely exhale against a resistance. The participants then removed the mouthpiece and continued to breathe normally until the next timed cycle.
- ✓ Each cycle was 10 seconds in duration.
- ✓ This procedure was repeated every 30seconds for 30min/day.
- ✓ A laptop computer displayed a timer and instructed the participant when to inhale and exhale.
- ✓ In addition, the computer program recorded each training session to measure subject compliance.

Fig-3.1- Respiratory Muscle Training Program Device

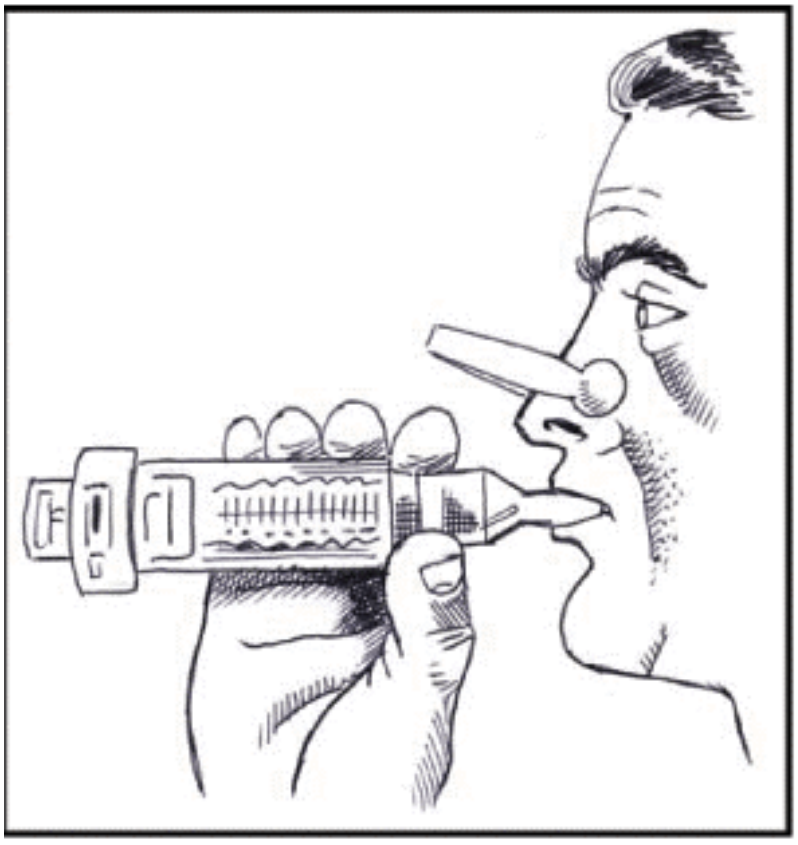


Fig -3.2 Respiratory Muscle Training Program - Procedure

GROUP-B

The subject of the Group B underwent Pursed Lip Breathing exercise and Spirometry exercises as per the procedure.

PURSED LIP BREATHING EXERCISE

1. Breathe in through your nose (as if you smell something) for about 2 seconds.
2. Pucker your lips like you're getting ready to blow out candles on a birthday cake.
3. Breathe out very slowly through pursed-lips, two to three times as long as you breathed in.
4. Repeat the procedure.

SPIROMETRY EXERCISES

- ✓ Breathe out (exhale) normally.
- ✓ Place the mouth piece in mouth. Seal the lips around the mouthpiece.
- ✓ Breathe in (inhale) slowly and deeply with lips sealed tightly on the mouthpiece. There is usually an indicator to show how slowly should inhale.
- ✓ After inhale as deeply as to can, hold the breath for at least 3 second.
- ✓ Remove the mouthpiece from mouth and breathe out normally.
- ✓ Repeat this technique as instructed, usually 10 to 15 times. Take a few normal breaths between deep breaths.
- ✓ When finished with the 10 to 15 exercises, it is very important to take a deep breath and cough. Should cough 2 to 3 times.

Fig -3.3 Spirometry device.

CHAPTER-IV

DATA PRESNTATION AND DATA ANALYSIS

3.2.1. STATISTICAL TOOLS

For the pre and post test experimental study, both paired 't'-test and unpaired 't'- test was used for each parameter to find out the significance of improvement achieved through intervention. Then unpaired 't'-test was used to find out the significance of the changes between two groups.

(a) PAIRED t-TEST

The paired t-test was used to find out the statistical significance between pre and post t-test values of PFT and MFIS in Group A and Group B.

Formula paired t-test

$$S = \frac{\sum d^2 - \frac{(\sum d)^2}{n}}{n-1}$$

$$t = \frac{\bar{d}\sqrt{n}}{s}$$

d = difference between the pre test V_s post test.

$\bar{d}$ = mean difference.

n = total number of subjects.

s = standard deviation.

(b) UNPAIRED t-TEST

The unpaired t- test was used to compare the statistically significance difference of PFT and MFIS in Group A and Group B.

Formula unpaired t-test

$$S = \sqrt{\frac{(n_1-1)s_1{}^2+(n_2-1)s_2{}^2}{n_1+n_2-2}}$$

$$t = \frac{|\bar{x}_1-\bar{x}_2|}{s\sqrt{\frac{1}{n_1}+\frac{1}{n2}}}$$

n_1 = Total number of subject in Group- A

n_2 = Total number of subject in Group- B

X_1 = Difference between the pre test and post test of Group- A

$\bar{X}_1$ = Mean difference between the pre test and post test of Group- A

X_2 = Difference between pre test and post test of Group- B

$\bar{X}_2$ = Mean difference between pre test and post test Group- B

S = Standard deviation

MAIN RESULTS

Table 4.1 and Figure 4.1shows the age distribution among the study. The patients were in the range of 30 years and above. The mean average age of Group A and Group B were 46.

TABLE-4.1

MEAN AVERAGE AGE GROUP OF GROUP A AND GROUP B

Mean Age Group	**Group A**	**Group B**
Male's	45	46
Female's	46	47

FIG-4.1 THE MEAN AVERAGE AGE OF GROUP A AND GROUP B

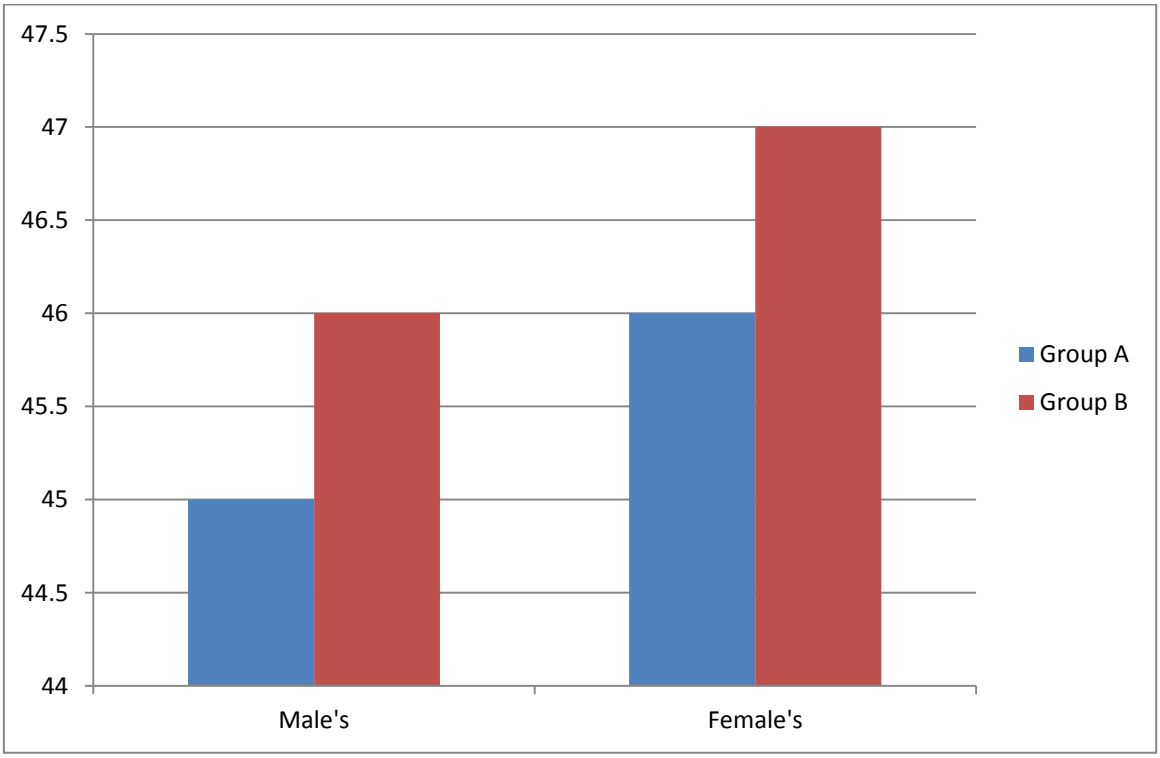


Table 4.2 and Figure 4.2shows the sex distribution among the study. There are 60% of females and 40% of males in both Groups.

TABLE-4.2

SEX DISTRIBUTION OF GROUP A AND GROUP B

Sex Distribution	Group A	Group B
Male's	6	5
Female's	9	10

FIG 4.2 SEX DISTRIBUTION OF GROUP A AND GROUP B

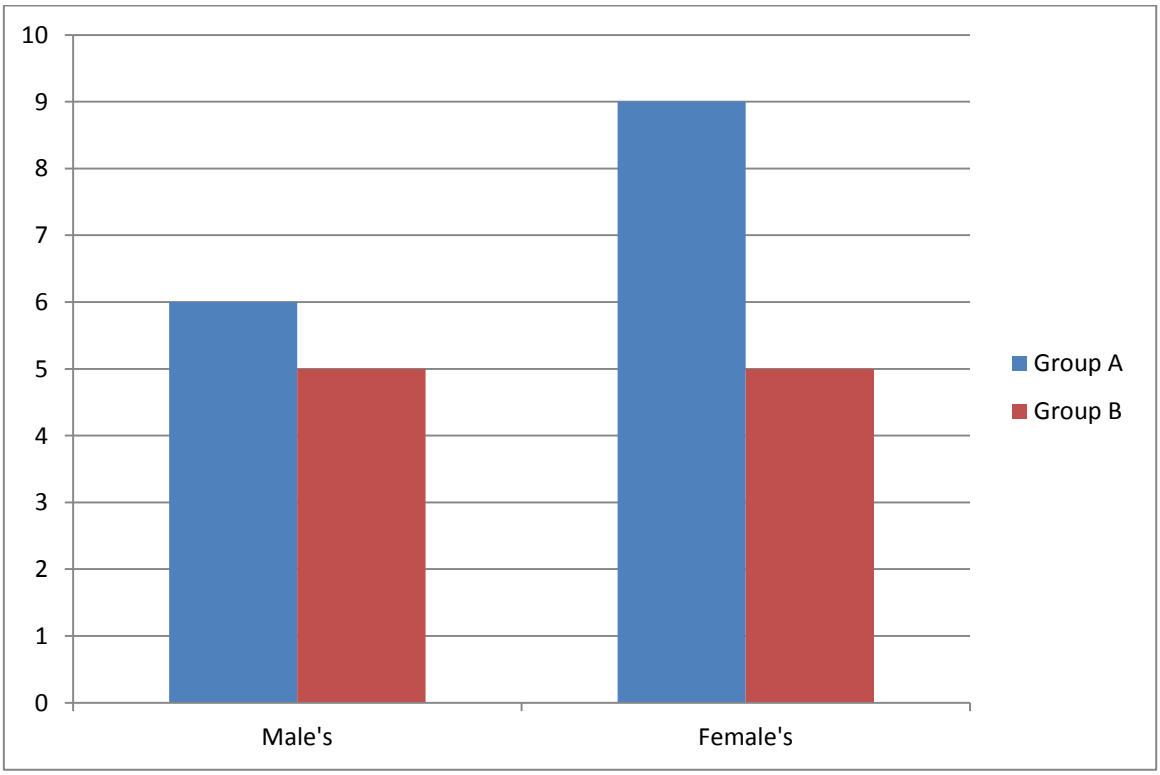


TABLE-4.3(a)

MEAN DIFFERENCE BETWEEN GROUP A AND GROUP B OF PFT

PFT	GROUPS	
	GROUP A	GROUP B
Tidal Volume	0.3	0.03
Vital Capacity	0.34	0.25

FIGURE-4.3 (a) MEAN DIFFERENCE BETWEEN GROUP A AND GROUP B OF PFT

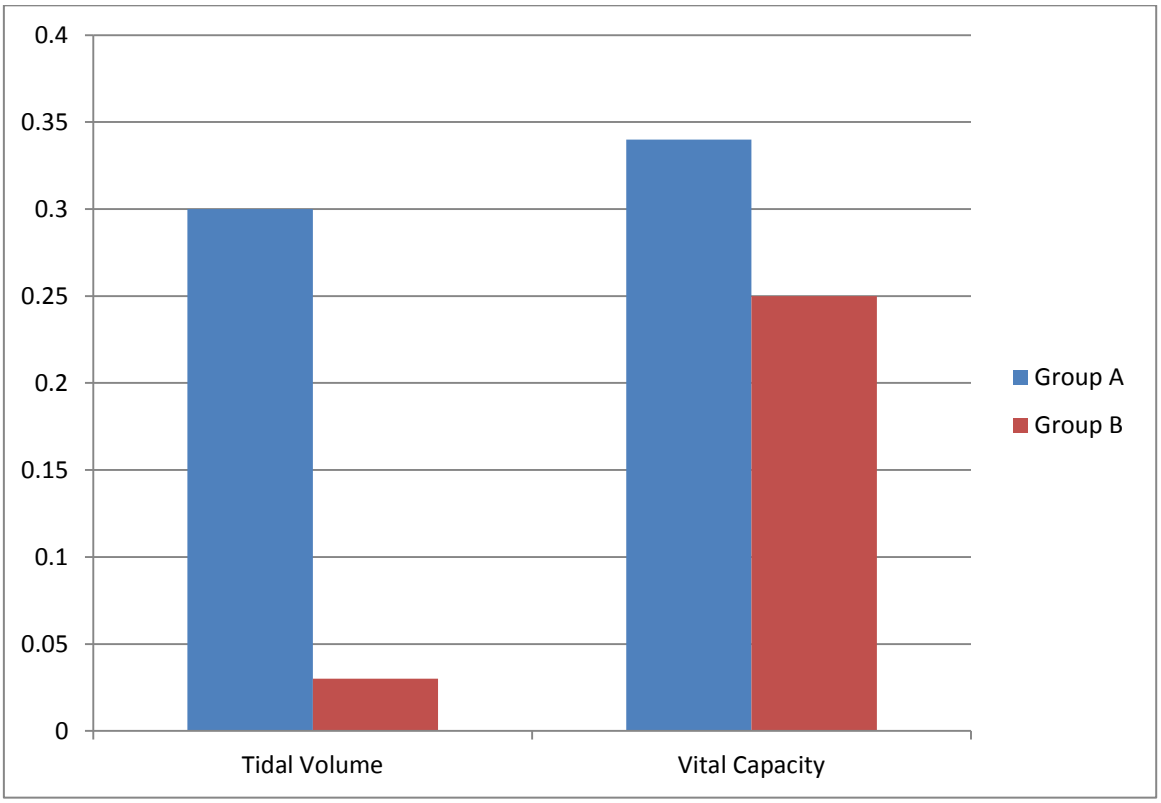


TABLE-4.3(b)

MEAN DIFFERENCE BETWEEN GROUP A AND GROUP B OF MFIS

GROUPS	MFIS
GROUP A	13.7
GROUP B	4.4

FIGURE-4.3 (b) MEAN DIFFERENCE BETWEEN GROUP A AND GROUP B OF MFIS

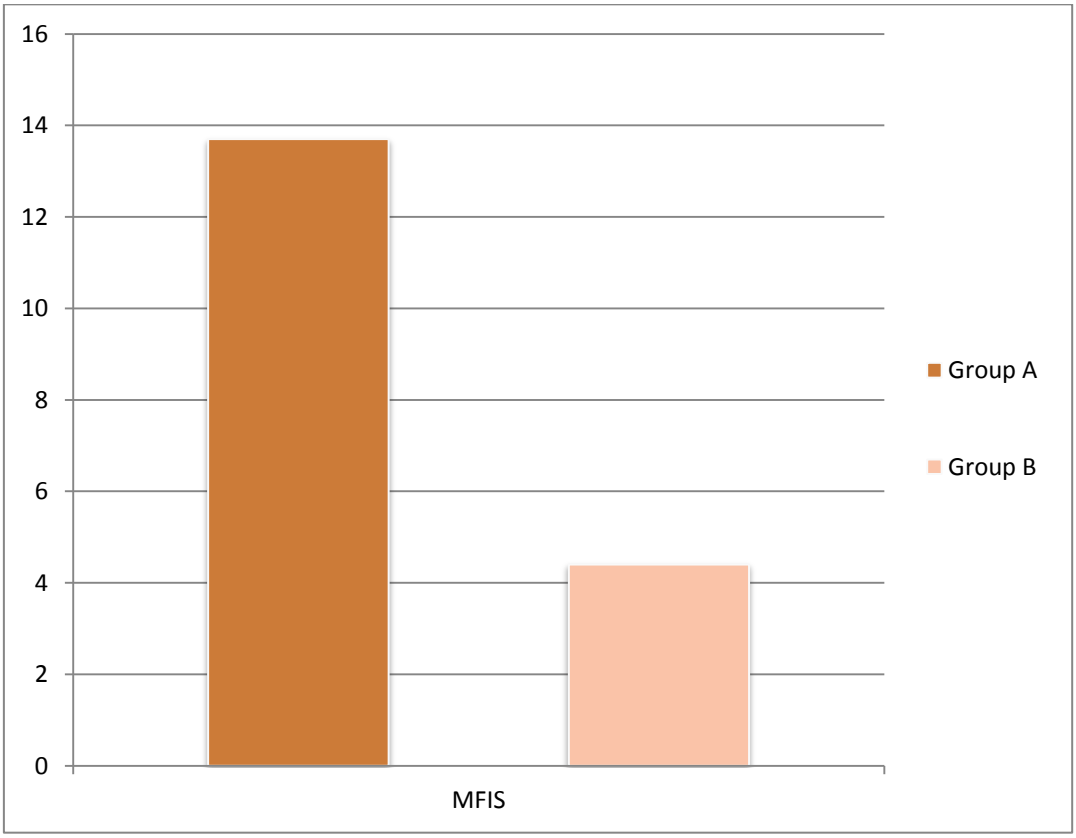


TABLE-4.4(a)

STANDARD DEVIATION BETWEEN GROUP A AND GROUP B OF PFT

PFT	GROUPS	
	GROUP A	GROUP B
Tidal Volume	0.223	0.109
Vital Capacity	0.148	0.109

FIGURE-4.4 (a) STANDARD DEVIATION BETWEEN GROUP A AND GROUP B OF PFT

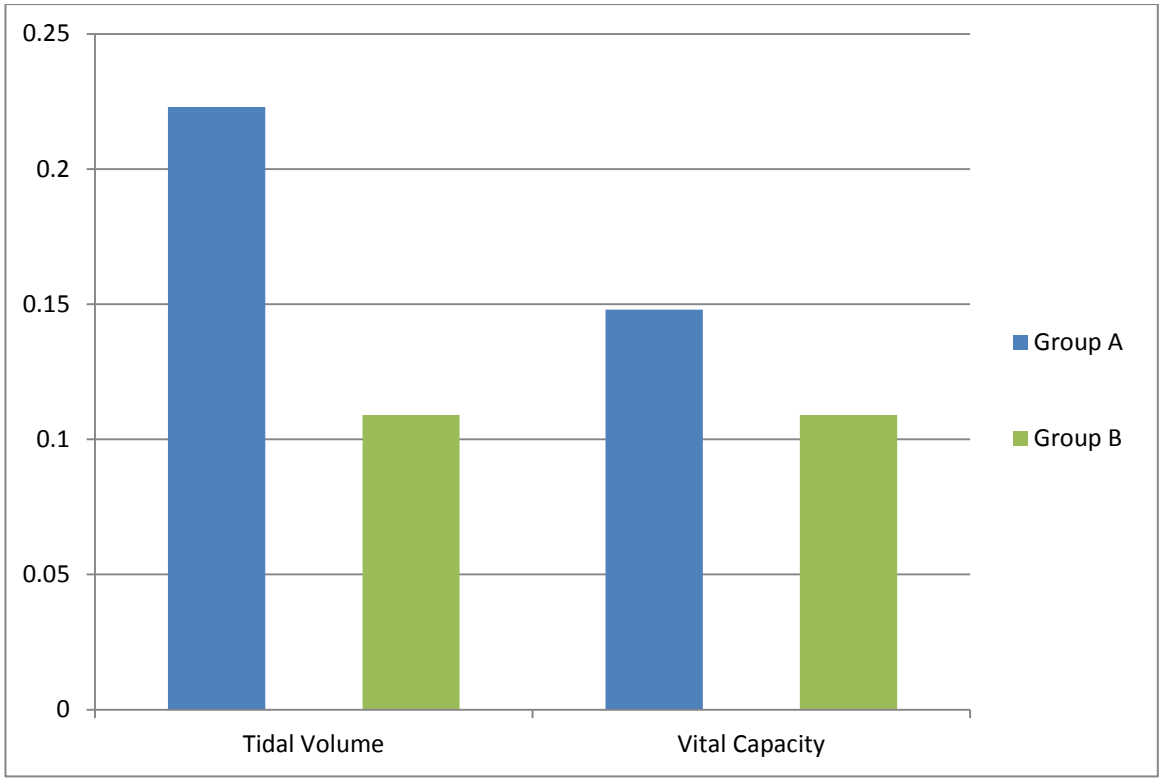


TABLE-4.4(b)

STANDARD DEVIATION BETWEEN GROUP A AND GROUP B OF MFIS

GROUPS	MFIS
GROUP A	4.27
GROUP B	1.59

FIGURE-4.4 (b) STANDARD DEVIATION BETWEEN GROUP A AND GROUP B OF MFIS

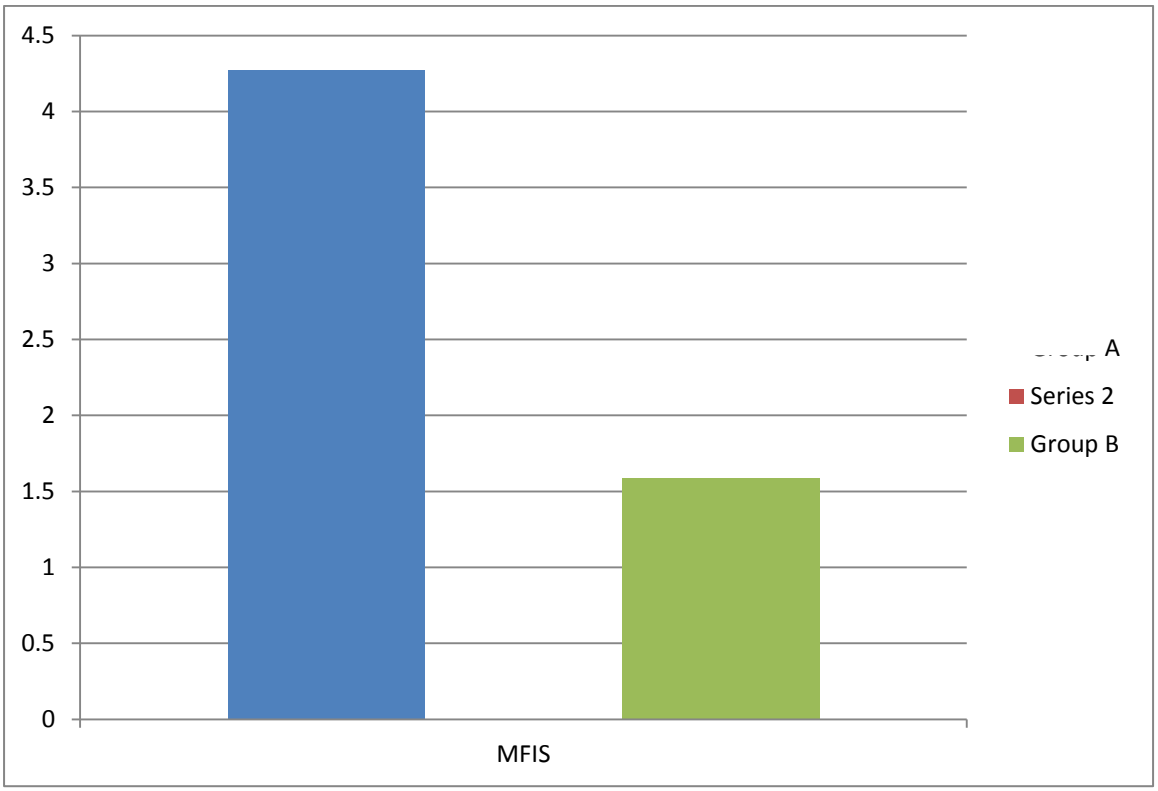


TABLE-4.5(a)

COMPARISON OF PAIRED 't' TEST AND TABLE VALUE BETWEEN GROUP A AND GROUP B OF PFT

PFT	GROUPS		Paired 't' Value	Significance
	GROUP A	GROUP B		
Tidal Volume	5.2	1.065	2.15	**Significant**
Vital Capacity	9.36	8.86	2.15	**Significant**

FIGURE-4.5 (a) COMPARISON OF PAIRED 't' TEST AND TABLE VALUE BETWEEN GROUP A AND GROUP B OF PFT

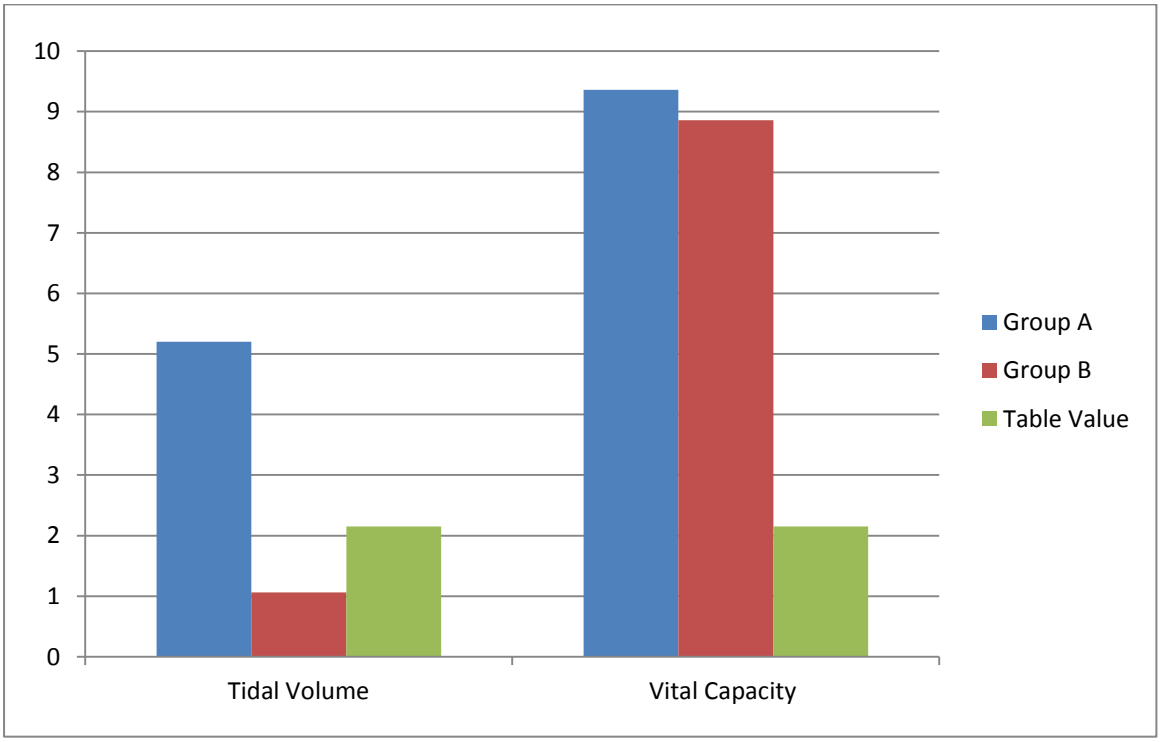


TABLE-4.5(b)

COMPARISON OF PAIRED 't' TEST AND TABLE VALUE BETWEEN GROUP A AND GROUP B OF MFIS

GROUPS	MFIS	Paired 't' Value	Significance
GROUP A	12.4	2.15	**Significant**
GROUP B	10.68	2.15	**Significant**

FIGURE-4.5 (b) COMPARISON OF PAIRED 't' TEST AND TABLE VALUE BETWEEN GROUP A AND GROUP B OF MFIS

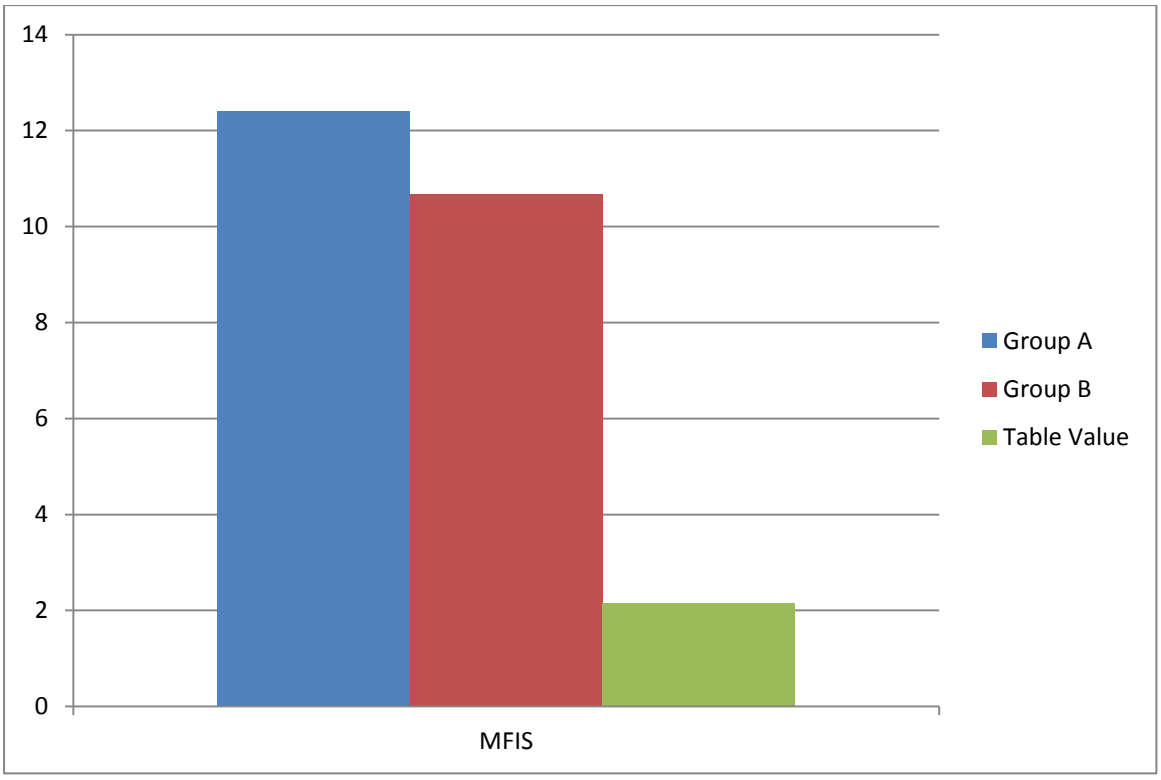
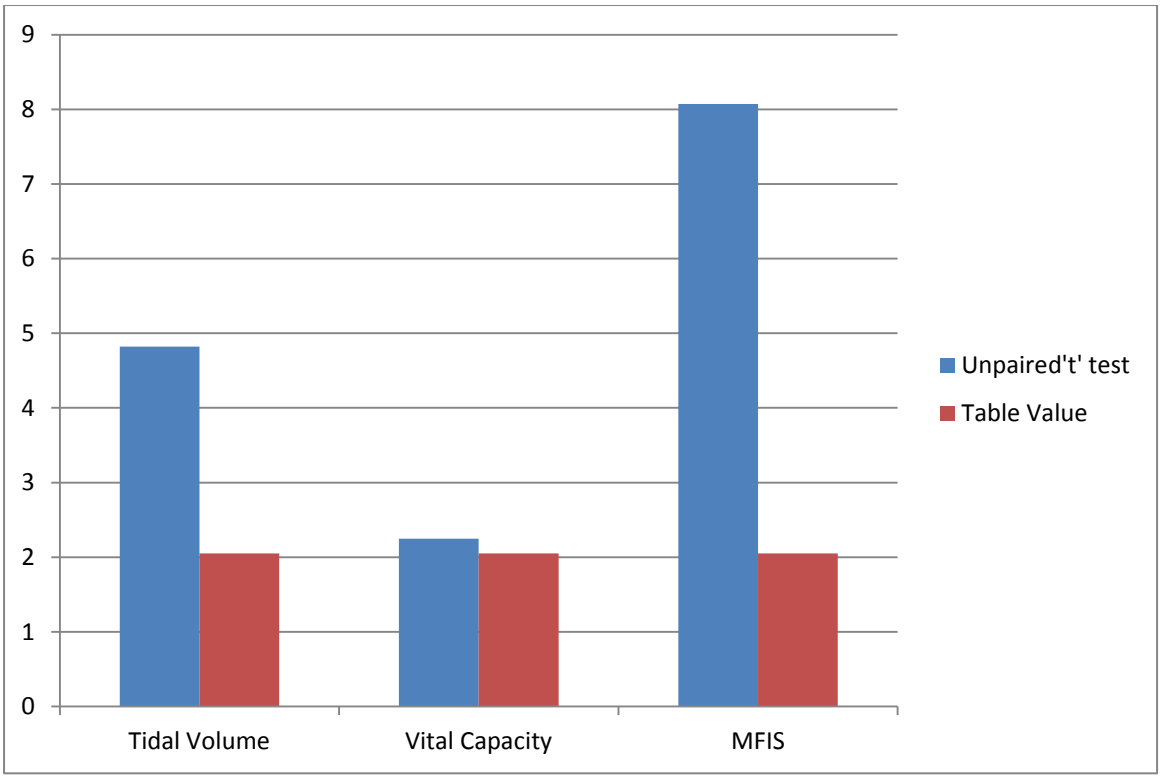


TABLE-4.6

COMPARISION OF UNPAIRED 't' TEST AND TABLE VALUE BETWEEN GROUP A AND GROUP B OF PFT & MFIS

PARAMETERS	UNPAIRED 't' TEST	TABLE VALUE	Significance
Tidal Volume	4.82	2.05	**Significant**
Vital Capacity	2.25	2.05	**Significant**
MFIS	8.07	2.05	**Significant**

FIGURE-4.6 COMPARISION OF UNPAIRED 't' TEST AND TABLE VALUE BETWEEN GROUP A AND GROUP B OF PFT & MFIS



CHAPTER-V

RESULTS AND DISCUSSION

5.1 RESULTS

The study sample comprised 30 patients, of which 15 were male and 15 were female. The mean age of patients was 46 years.. The median time interval between PFT and MFIS questionnaires applied before and after therapy was 5 weeks. Among 30 patients, 15 were treated with Respiratory Muscle Training program, and 15 were treated with Pursed Lip Breathing with Spirometry Exercises.

The pre and post test values were assessed by PFT and MFIS in group A. The mean difference value is 0.3, 0.34 and 13.7 respectively. The standard deviation value is0.223,0.148 and 4.27 respectively. The paired ' t ' test value for PFT and MFIS 5.2,9.36 and 12.4.The paired ' t ' test value is more than table value 2.15 for 5% level of significance at 14 degrees of freedom.

The pre and post test values were assessed by PFT and MFIS in group B. The mean difference value is 0.03,0.25 and 4.4 respectively. The standard deviation value is 0.109,0.109 and 1.59 respectively. The paired ' t ' test value for PFT and MFIS is 1.065,8.86 and 10.68 . The paired ' t ' test value is more than table value 2.15 for 5% level of significance at 14 degrees of freedom.

The calculated ' t ' values by unpaired ' t ' test were 4.82, 2.25 and 8.07. The calculated ' t ' values were more than the table value 2.05 for 5% level of significance at 28 degrees of freedom.

The paired ' t ' test values have shows that Respiratory Muscle Training program was more effective than Pursed Lip Breathing With Spirometry Exercises for patients with Multiple sclerosis. The unpaired ' t ' test values have shown that there was significant difference between two groups in showing improvement in their quality of life in patients with Multiple sclerosis.

5.2 DISCUSSION

This small preliminary study demonstrate that a short duration RMT program designed to train both the inspiratory and expiratory muscles can increase inspiratory and expiratory muscle strength, reduce fatigue, and in MS patients who present with relatively normative pulmonary function.

We suggest the slight variation in respiratory muscle strength between groups may be because of a higher disability level and a longer time since diagnoses in the control group Participants were not excluded based on near normative pulmonary function, because these measures do not correlate with maximal respiratory muscle strength. Also, participants with Normative pulmonary function are still capable of benefiting from RMT, as demonstrated by multiple studies with healthy participants.

The improvements in respiratory muscle strength were consistent with previous RMT studies in healthy participants using a similar protocol. Despite improvements in respiratory muscle strength, gains in functional status were not observed in this study. It is possible that our subjects did not improve as limited as other participants with MS of the same disability level, or the level of exertion during the functional tasks may have not been sufficient to stress the respiratory system. In addition, it is not uncommon for individuals with MS to pace themselves during physical activity in order to preserve function and reduce fatigue levels, both in the short and long term.

Although functional status did not improve, overall fatigue levels did for the RMT group. The control group had a tendency for worsening fatigue, self-efficacy, over the short 5-week period. It is difficult to postulate why the control group worsened over such a short period of time, because both groups were tested during the same time of year, and all testing was performed in a climate-controlled environment to reduce the effects of heat. No participants reported changes in health status during the 5-week period.

It is not unique that fatigue was shown to interfere with Normative functioning of all participants in this study. This is consistent with previous studies highlighting the prevalence of MS-related fatigue. RMT improved physical and cognitive levels of fatigue, whereas psychosocial fatigue did not change (for either group). This is important, because changes in physical, cognitive, and psychosocial fatigue facilitate enhanced community mobility and social participation, thereby improving quality of life. After 5 weeks of RMT, energy/fatigue, general health, and role limitations because of physical health improved.

The participants from the current study subjectively stated that they felt better and could accomplish more during the day after training. It is possible that participants were able to accomplish more because respiratory work/fatigue was reduced after training, allowing redistribution of blood to other working muscles during strenuous tasks.

MS is associated with a dramatic reduction in physical activity. Although there were no changes in activity, the RMT participants subjectively stated that they were able to accomplish more throughout the day with less fatigue. In contrast, the control group demonstrated a reduction in their physical activity in 5 weeks.

This may explain why few changes in the PFT and MFIS were observed, even though the participants subjectively reported an overall increase in their self-efficacy, that is, they could accomplish more because of the decrease in fatigue.

The Group B participants showed a decline in self-efficacy. Studies have shown that self-efficacy has a direct positive relation with physical activity. 30 Individuals with higher satisfaction levels are more independent in self-care and housekeeping tasks, as well as engaged in more leisure activities, compared with those who have low self-efficacy.

This study has proven that the effectiveness of a Respiratory Muscle Training Program improves total lung volumes and capacities and reduces fatigue in patients with multiple sclerosis.

5.3 LIMITATIONS

- The study has been conducted on small size sample only .
- This study took shorter duration to complete.
- This study limitation include only multiple sclerosis patient.
- This study not extended 5 weeks for a patient due to time constraint.

5.4 RECOMMENDATIONS

- A similar study may be extended with large sample.
- The future study can also compared with various techniques.
- This study may also applied to other conditions.

CHAPTER - VI

SUMMARY AND CONCLUSION

In our samples, the effectiveness of a Respiratory Muscle Training program improves total lung volumes and capacities and reduce the level of fatigue in patient with multiple sclerosis.

The Pulmonary Function Test and MFIS Score difference in multiple sclerosis patients before and after treatment were statistically significant.

Through the results, alternate hypothesis is accept and also the study could be concluded that there is a significant difference in the effects of a Respiratory Muscle Training program improves total lung volumes and capacities and reduce the level of fatigue in patients with multiple sclerosis.

BIBLOGRAPHY

1. **Gosse link R, Kovacs L, Ketelaer P, Carton H, Decramer M.** *Respiratory muscle weakness and respiratory muscle training in severely disabled multiple sclerosis patients. Arch Phys Med Rehabil 2000;81:747-51.*
2. **Mutluay FK, Gurses HN, Saip S**. *Effects of multiple sclerosis on respiratory functions. Clin Rehabil 20*
3. **Bosnak-Gucla M, Guclu-Gunduz A, Nazleiel B, Irkec C.** *Comparison of functional exercise capacity, pulmonary function and respiratory muscle strength in patients with multiple sclerosis with different disability levels and health controls. J Rehabil*
4. **Mador MJ, Acevedo FA.** *Effect of respiratory muscle fatigue on subsequent exercise performance. J Appl Physiol 1991;70:2059-65*
5. **Smeltzer SC, Utell MJ, Rudick RA, Herndon RM.** *Pulmonary function and dysfunction in multiple sclerosis. Arch Neurol 1988;45:1245-9.*
6. **Foglio K, Clini E, Facchetti D, et al.** *Respiratory muscle function and exercise capacity in multiple sclerosis. Eur Respir J 1994;7:23-8.*
7. **Chiara T, Martin AD, Davenport PW, et al.** *Expiratory muscle strength training in persons with multiple sclerosis having mild to moderate disability: effect on maximal expiratory pressure, pulmonary function, and maximal voluntary cough. ArchPhysMedRehabil2006;87:468-73.*
8. **Tantucci C, Massucci M, Piperno R, Betti L, Grassi V, Sorbini CA.** *Control of breathing and respiratory muscle strength in patients with multiple sclerosis. Chest 1994;105:1163-70.*
9. **SmeltzerSC,SkurnickJH,TroianoR,CookSD,DuranW,LavietesMH.** *Respiratory function in multiple sclerosis. Utility of clinical assessment of respiratory muscle function. Chest 1992; 101:479-84.*
10. **Pfalzer LA, Fry DK.** *Effects of a 10-week inspiratory muscle training program on lower extremity mobility in people with multiple sclerosis a randomized controlled trial. Int J MS Care 2011;13:32-42.*
11. **Mutluay FK, Demir R, Ozyilmaz S, Caglar AT, Altintas A,** *Gurses HN. Breathing enhanced upper extremity exercises for patients with multiple sclerosis. Clin Rehabil 2007; 21:595-602.*
12. **Sapienza CM, Wheeler K**. *Respiratory muscle strength training: functional outcomes versus plasticity. Semin Speech Lang 2006;27:236-44.*

13. **Fry DK, Pfalzer LA, Chokshi AR, et al**. *Randomized control trial of effects of a 10-week inspiratory muscle training program on measures of pulmonary function in persons with multiple sclerosis. J NeurolPhysTher 2007;31:162-72.*
14. **Klefbeck B, HamrahNedjad J, Klefbeck B, HamrahNedjad J.** *Effect of inspiratory muscle training in patients with multiple sclerosis. ArchPhys Med Rehabil 2003;84:994-9.*
15. **Leddy JJ, Limprasertkul A, Patel S, et al.***Isocapnic hyperpnea training improves performance in competitive male runners. Eur J ApplPhysiol 2007;99:665-76.*
16. **Ray AD, Pendergast DR, Lundgren CE.** *Respiratory muscle training reduces the work of breathing at depth. Eur J ApplPhysiol 2010;108:811-20.*
17. **Ray AD, Pendergast DR, Lundgren CE.** *Respiratory muscle training improves swimming endurance at depth. Undersea Hyperb Med 2008;35:185-96.*
18. **Wilson SH, Cooke NT, Edwards RH, Spiro SG.** *Predicted normal values for maximal respiratory pressures in Caucasian adults and children. Thorax 1984;39:535-8.*
19. **Lindholm P, Wylegala J, Pendergast DR, Lundgren CE**. *Resistive respiratory muscle training improves and maintains endurance swimming performance in divers. Undersea Hyperb Med 2007;34:169-80.*
20. **American Thoracic Society/European Respiratory Society.** *ATS/ERS Statement on respiratory muscle testing. Am J RespirCrit Care Med2002;166:518-624.*
21. **Fisk JD, Ritvo PG, Ross L, Haase DA, Marrie TJ, Schlech WF.** *Measuring the functional impact of fatigue: initial validation of the fatigue impact scale. Clin Infect Dis 1994;18(Suppl 1):S79-83.*
22. **Einarsson U, Gottberg K, Fredrikson S, von Koch L, Holmqvist LW.***Activities of daily living and social activities in people with multiple sclerosis in Stockholm County. Clin Rehabil 2006;20:543-51.*
23. **Ware JE. SF**-*36 health survey update. Spine 2000;25:3130-9.*
24. **Kayes NM, Schluter PJ, McPherson KM, et al.** *The Physical Activity and Disability Surveye Revised (PADS-R): an evaluation of a measure of physical activity in people with chronic neurological conditions .ClinRehabil 2009;23:534-43.*
25. **Uemura H, Lundgren CE, Ray AD, Pendergast DR.** *Effects of different types of respiratory muscle training on exercise performance in runners. Mil Med 2012;177:559-66.*

26. **Wylegala JA, Pendergast DR, Gosselin LE, Warkander DE,Lundgren CE.** *Respiratory muscle training improves swimming endurance in divers. Eur J ApplPhysiol 2007;99:393-404.*
27. **Krupp LB, Alvarez LA, LaRocca NG, Scheinberg LC.** *Fatigue in multiple sclerosis. Arch Neurol 1988;45:435-7.*
28. **Harms CA, Babcock MA, McClaran SR, et al**. *Respiratory muscle work compromises leg blood flow during maximal exercise. J ApplPhysiol 1997;82:1573-83.*
29. **Motl RW, Snook EM, McAuley E, Gliottoni RC.** *Symptoms, self-efficacy, and physical activity among individuals with multiple sclerosis. Res Nurs Health 2006;29:597-606.*
30. **Lundmark P, Branholm IB.** *Relationship between occupation and life satisfaction in people with multiple sclerosis. Disabil Rehabil 1996;18:449-53.*
31. **Knudson RJ, Lebowitz MD, Holberg CJ, Burrows B.** *Changes in the normal maximal expiratory flow-volume curve with growth and aging. Am Rev Respir Dis 1983;127:725-34.*

REFERENCES

1. Differential diagnosis physical therapy-**Good man and Snyder**
2. Neurological differential diagnosis **–John Peter**
3. Neurology and neuro illustrated-**KennethW..linday, Lan Bone and Geraint Fuller.**
4. Merritt's neurology-**Lewis R.Rowland**
5. Clinical neurology-**Navneet Kumar**
6. Hand book of practical neurology physiotherapy-**Pk Mitra**
7. Disability evaluation-**Stephenl.Demeter,Gunnar B.J.Anderson**
8. Neurological physiotheraphy-**Susan Edwards**
9. Physical regabilitation-**Susan B.O' Sullivan**
10. Neurological regabilitation-**Umphred**
11. Neurology for the non-neurologist-**William J.Weiner, Christopher G. Goetz**.
12. Essentials of medical physiology-**K.Sembulingam**

WEBSITES

1. www.ncbi.nlm.gov
2. www.neuropt.org
3. www.pft.com.in
4. www.pubmed.org
5. www.multiple sclerosis.org
6. www.mfis.org

APPENDIX-I

MULTIPLE SCLEROSIS ASSESMENT FORM

1. Name :
2. Age :
3. Sex :
4. Occupation :
5. Residential address :
6. Date of assessment :
7. Date of birth :
8. Signs & symptoms :

Free	5
Minimal sign & symptoms	4
Moderate signs	3
Marked signs	2
Severe signs	1
Unaccepted signs	0
Total →	
Comments →	

9. Coping: process of managing environment

Able to coping	5
Minimal problem	4
Copes moderately well	3
Marked problem	2
Severe	1
Not all coping	0
Total →	
Comments →	

10.Pulmonary function test

(a)Lung volumes

Lung volumes	Approximate normal lung volumes (values in Litres)
Tidal volume	500
Inspiratory reserve volume	2500
Expiratory reserve volume	1000
Residual volume	1500
Total →	
Comments →	

(b)Lung capacities

Lung capacities	Approximate lung capacities(values in Litres)
Inspiratory capacity	3000
Vital capacity	4000
Functional residual capacity	2500
Total lung capacity	5500
Total →	
Comments →	

11.Understanding:

Full understanding	5
Good understanding, minimal	4
Moderate	3
Marked	2
severe	1
Totally inaccurate	0
Total →	
Comments →	

12.Pain:

Type	Location	Time Day /Night	Duration	Severity
Comments →				

13.Activities of Daily Living (ADL):

ADL	No help	Maximum help	Moderate help	Minimum help	Unable comments
Dressing					
Eating					
Ambulation					
Toileting					
Personal hygiene					
Comments →					

14.Associate problems:

	Severe	Moderate	Minimal	Involvement of other agencies	comment
Urinary incontinence					
Fecal incontinence					
Depression					
Anxiety					
Memory					
Language problem					
Perceptual problem					
Speech					
Swallowing					
Trigeminal neuralgia					
Comments→					

15.Function

Full	5
Minimal restriction	4
Moderate	3
Marked	2
Severe	1
No function	0
Total→	
Comments →	

16.Tone assessment:

Score	Date	Upper limb	Lower limb
0	No movement No function		
1	Some movement No function		
2	Some movement Some function		
3	Good function Good tone		
4	Normal tone		
Total →			
Comments →			

17Daily activity:

	Date
Bed bound	
In bed mostly in chair someday	
In chair most of the day	
In bed but gets up go to commode & bathroom	
In chair & but gets up go to commode & bathroom	
Normal Daily Activities but needs rest	
Normal Daily Activity with in home	
Part time job	
Full time job	
Total →	
Comments →	

18.Range of motion, Power:

	Right		Left		
Region	ROM	Power	ROM	Power	Deformity
Cervical F/E Shoulder Elbow Wrist Lumbar Hip Knee Ankle DF/PF Toes F/E Comments →					

19.Lying to sitting:

Grade	
0	Unable
1	With fair assistance one (or) two helpers
2	Sitting with help with abnormal posture
3	Independent sitting but abnormal posture
4	Independent sitting with normal posture
Total →	
Comments→	

20.Unsupported sitting:

Date	Grade
Unable	0
Sitting abnormal posture with arm support	1
Independent sitting abnormal pattern	2
Independent sitting normal movement	3
Independent dynamic sitting	4
Total →	
Comments →	

21.Sit to stand:

Unable to lift	0
With assistance of one (or) two	1
With facilitation	2
Independent with abnormal pattern	3
Independent to normal movement	4
Total →	
Comments →	

22.Transfer to both sides:

Unable	0
With assistance of one (or) two	1
Independent to one side	2
Independent to one side but abnormal pattern	3
Independent to abnormal pattern	4
Independent to normal movement	5
Total →	
Comments →	

23.Standing:

Unable	0
Stand with two assistance	1
Stand with one assistance	2
Stand with minimal support	3
Dynamic standing	4
Total →	
Comments →	

24.Walking:

Unable	0
Walk with two assistance	1
Walk with one (or) two assistance	2
Independent with abnormal pattern	3
Independent with normal pattern	4
Total →	
Comments →	

25.Type of Gait:

26.Balance:

27Sensation:

	Normal		Abnormal	
	Right	Left	Right	Left
Upper limb				
Lower limb				
Trunk				
Head				
Comments →				

28.Proprioception:

	Normal		Abnormal	
Upper limb	Right	Left	Right	Left
Lower limb				
Trunk				
Head				
Comments →				

29.

S. NO	Date	Problem list	Treatment

APPENDIX-II

Patient's Code: _____ Date: _____/_____/_____
month day year
Test#: 1 2 3 4

MODIFIED FATIGUE IMPACT SCALE (MFIS)

INSTRUCTIONS

Following is a list of statements that describe how fatigue may affect a person. Fatigue is a feeling of physical tiredness and lack of energy that many people experience from time to time. In medical conditions like MS, feelings of fatigue can occur more often and have a greater impact than usual. Please read each statement carefully, and then **circle the one number** that best indicates how often fatigue has affected you in this way during the **past 4 weeks.** (If you need help in marking your responses, **tell the interviewer the number** of the best response.) **Please answer every question.** The interviewer can explain any words or phrases that you do not understand.

Because of my fatigue during the **past 4 weeks…**

	Never	Rarely	Some-times	Often	Almost Always
1. I have been less alert.	0	1	2	3	4
2. I have had difficulty paying attention for long periods of time.	0	1	2	3	4
3. I have been unable to think clearly.	0	1	2	3	4
4. I have been clumsy and uncoordinated.	0	1	2	3	4
5. I have been forgetful.	0	1	2	3	4
6. I have had to pace myself in my physical activities.	0	1	2	3	4
7. I have been less motivated to do anything that requires physical effort.	0	1	2	3	4
8. I have been less motivated to participate in social activities.	0	1	2	3	4
9. I have been less motivated to do things away from home.	0	1	2	3	4
10. I have had trouble maintaining physical effort for long periods.	0	1	2	3	4
11. I have had difficulty making decisions.	0	1	2	3	4
12. I have been less motivated to do anything that requires thinking.	0	1	2	3	4
13. My muscles have felt weak.	0	1	2	3	4
14. I have been physically uncomfortable.	0	1	2	3	4
15. I have had trouble finishing tasks that require thinking.	0	1	2	3	4
16. I have had difficulty organizing my thoughts when doing things at home or at work.	0	1	2	3	4
17. I have been less able to complete tasks that require physical effort.	0	1	2	3	4
18. My thinking has been slowed down.	0	1	2	3	4
19. I have had trouble concentrating.	0	1	2	3	4
20. I have limited my physical activities.	0	1	2	3	4
21. I have needed to rest more often or for longer periods.	0	1	2	3	4

APPENDIX –III

ETHICAL CLEARANCE

Ethically permission for the study will be obtained from the subjects and a written consent will be taken from each subject who participates in the study, As this study involve human subjects the Ethical Clearance has been obtained from the Ethical committee of Nandha College Of Physiotherapy, Erode as per the ethical guidelines for Bio-medical research on human subjects, 2000 ICMR, (Indian council of Medical Research) New Delhi.

Written Informed Consent Form

NANDHA COLLEGE OF PHYSIOTHERAPHY,

ERODE.

Informed consent form for the volunteers at "Nandha College of Physiotherapy, Erode", who will be participating in the research project entitled " **THE EFFECTIVENESS OF RESPIRATORY MUSCLE TRAINING PROGRAM (RMT) IMPROVES TOTAL LUNG VOLUMES AND CAPACITIES AND REDUCES FATIGUE IN PATIENTS WITH MULTIPLE SCLEROSIS"**

Name of Principal Investigator	**Reg. No.271620061** Post graduate student
Name of Organization	Department of physiotherapy in neurology, Nandha College of Physiotherapy, Erode

This Informed Consent Form has two parts:

Information Sheet (to share information about the research with you)

Certificate of consent (for signatures if you agree to take part)

You will be given a copy of the full Informed Consent Form

PART I: Information Sheet

Introduction

I ---------- , postgraduate student in the physiotherapy department of neurology, Nandha College Of Physiotherapy, Erode, am working on my dissertation titled " **the effectiveness of a Respiratory Muscle Training program improves total lung volumes and capacities and reduces fatigue in patients with multiple sclerosis".** I am going to give you information and invite you to be part of this research. You do not have to decide today whether or not you will participate in the research. Before you decide, you can talk to anyone you feel comfortable with about the research.

There may be some words that you do not understand. Please ask me to stop as we go through the information and I will take time to explain. If you have questions later, you can ask them and get yourself clarified.

Purpose of research

Type of Research Intervention

In this study if you are selected, detailed history taking, clinical examination and routine investigation will be done.

Participant selection

Study group: Adult between age group of 30 years with fatigue related multiple sclerosis will be recruited in study group after obtaining the informed consent. Detailed history, clinical examination and routine blood investigation will be done. After explaining the procedure all the patients will be divided into two study groups each study group consisting at least 15 patients. First study group will be treated with Respiratory Muscle Training program. Second study group with Pulsed Lip Breathing exercise with Spirometry. Evaluation of outcome will be done for each study Group at the end of Second week. The data will be analyzed statistically.

Duration: 12 months

Voluntary participation

Your participation in this research is entirely voluntary. It is your choice whether you choose to participate or not, it will not affect our patient's treatment process.

Benefits

Personally you might be or may not be benefited in any way directly from the research. But by taking part in this research, you will be helping the scientific community.

Possible risks

There are no major physical risks for the person associated with these methods. Complications include exacerbation of symptoms after maneuver which is rare possibility

Reimbursements

You won't be given any monetary incentives or gifts for being a part of this research

Confidentially

The information that we collect from this research project will be kept confidential. Information about the patient that will be collected during the research will be put away and no-one but the research will be able to see it.

Right to Refuse or Withdraw

You do not have to take part in this research if you do not wish to do so. You may also stop participating in the research at any time you choose. It is your choice and all of your rights will still be respected.

Who to Contact

This proposal has been reviewed and approved by the Research and Ethical committee of Nandha College of Physiotherapy, Erode, which is a committee whose task it is to make sure that research participants are protected from harm

You can ask me any more questions about any part of the research study, if you wish to. Do you have any questions?

PART II: Certificate of consent

I have read the foregoing information, or it has been read to me. I have been explained the procedure and complication. I am willing to participate in the study. I have had the opportunity to ask questions about it and any questions that I have asked have been answered to my satisfaction. I consent voluntarily to participate as a participant in this research

Name of the participant _____

Signature of participant _____

Date _____Day/month/year

If illiterate witness must sign (if possible, this person should be selected by the participant and should have no connection to the research team). Participants who are illiterate should include their thumb-print as well.

I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely

Name of witness _____ Thumb print of participant

Signature of witness _____

Date _____

Statement by the researcher/person taking consent

I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands that the following will be done:

1. Blood investigation

Hb, TC, DC, ESR, RBS, Serum electrolytes, Blood Urea and Serum Creatinine.

2. Respiratory Muscle Training program(RMT)

3. Pursed Lip Breathing exercise

I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving a copy of this informed consent from has been provided to the participant

Name of Researcher/person taking the consent _____

Signature of Researcher/person taking the consent _____

Date---------- Day/month/year

APPENDIX –IV

DATA PRESENTATION

PRE AND POST TEST FOR GROUP-A (PFT,MFIS)

S.NO	AGE	SEX	TIDAL VOLUME		VITALCAPACITY		MFIS	
			PRE SCORE	POST SCORE	PRE SCORE	POST SCORE	PRE SCORE	POST SCORE
1	40	F	0.42	0.48	4.4	4.6	60	42
2	42	F	0.40	0.46	4.4	4.8	62	40
3	45	F	0.32	0.48	4.6	4.8	58	46
4	46	M	0.46	0.50	4.2	4.6	54	42
5	43	F	0.42	0.46	3.8	4.2	56	44
6	44	M	0.44	0.48	4.6	4.8	58	46
7	41	M	0.46	0.50	4.0	4.2	60	42
8	47	F	0.38	0.42	4.2	4.6	54	48
9	46	F	0.46	0.50	4.0	4.8	62	44
10	42	M	0.44	0.48	4.6	4.8	56	46
11	44	F	0.46	0.50	4.4	4.6	58	42
12	43	M	0.42	0.48	4.6	4.8	56	42
13	45	F	0.38	0.46	4.2	4.6	62	44
14	41	F	0.46	0.46	4.2	4.8	58	42
15	44	M	0.42	0.348	4.0	4.6	54	48

DATA PRESENTATION

PRE AND POST TEST FOR GROUP-B (PFT,MFIS)

S.NO	AGE	SEX	TIDAL VOLUME		VITALCAPACITY		MFIS	
			PRE SCORE	POST SCORE	PRE SCORE	POST SCORE	PRE SCORE	POST SCORE
1	40	F	0.32	0.40	3.6	3.8	82	78
2	42	F	0.36	0.38	3.8	4.0	84	78
3	45	F	0.38	0.40	3.4	3.6	80	74
4	46	M	0.34	0.38	3.4	3.8	82	78
5	43	F	0.36	0.38	3.8	4.0	78	74
6	44	M	0.38	0.40	3.6	3.8	78	74
7	41	M	0.32	0.36	3.4	3.8	84	76
8	47	F	0.34	0.36	3.4	3.6	80	78
9	46	F	0.30	0.34	3.8	4.0	84	78
10	42	M	0.32	0.36	3.4	3.6	82	78
11	44	F	0.32	0.34	3.2	3.4	82	78
12	43	M	0.36	0.38	3.8	4.0	78	74
13	45	F	0.32	0.34	3.4	3.6	78	76
14	41	F	0.34	0.38	3.4	3.6	84	80
15	44	M	0.36	0.38	3.2	3.8	82	78

APPENDIX - V

ABSTRACT

Aim: The Aim of this study is to compare **"**the effectiveness of respiratory muscle training program (RMT) improves total lung volumes and capacities and reduces fatigue in patients with multiple sclerosis"

Materials and Methods: A Quasi Experimental study design consisting of reviews of charts of MULTIPLE SCLEROSIS patients. Thirty patients were included, (60%) were females,(40%) were males ; the average age was 46 years. All the patients are presented with MULTIPLE SCLEROSIS underwent PFT & MFIS test. Pre- and post-Treatment of Group A patients received (Respiratory Muscle Training program) and Group B patients received (Pursed Lip Breathing with Spirometry exercise) scores on the vital capacity, lung volume, physical, functional and emotional dimensions of the PFT and MFIS were analyzed.

Results: The pre and post test values were assessed by PFT and MFIS in Group A and Group B. The calculated' t' values by unpaired' t' test were in group A is **4.82, 2.25** and Group B is **8.07.** The calculated' t' values were more than the table value **2.05** for **5%** level of significance at **28** degrees of freedom.

Conclusion: In the present sample, Respiratory Muscle Training Program had a positive and significant effect on the vital capacity, lung volume, emotional, physical and functional dimensions of quality of life, as measured by the PFT and MFIS scores before and after therapy.

Keywords: Respiratory Muscle Training Program, Pursed Lip Breathing With Spirometry Exercise, Pulmonary Function Test, Modified Fatigue Impact Scale.